

## PATENT ABSTRACTS OF JAPAN

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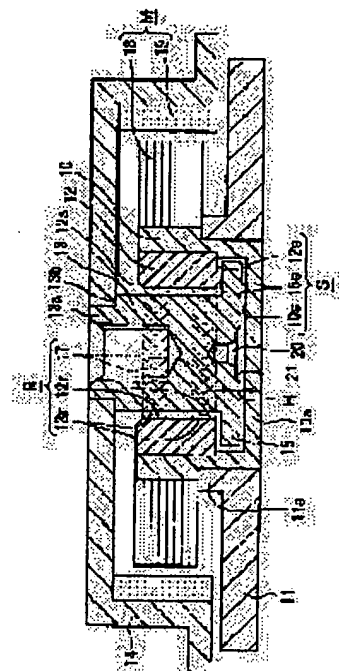
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## (54) FLUID BEARING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a thin-type fluid bearing device having superior impact resistance and hardly causing unstable vibration even in changing the using environment.

SOLUTION: A spindle motor is provided with a shaft 13 having a flange portion 15 integrally formed in one end, sleeves 12 opposed to each other in the shaft 13 via a fluid bearing clearance of a radial fluid bearing R, and a center hole 20 in the end surface on the side provided with the flange part 15 in both end surfaces of the shaft 13. The center hole 20 is closed by filling the center hole 20 with filler.



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**CLAIMS**

[Claim 1] Liquid bearing equipment characterized by having been filled up with the bulking agent in said crevice, and taking up this crevice in the liquid bearing equipment which equips with a crevice the end face of the side in which said flange was prepared among the ends sides of said shaft while having the shaft which has the flange formed in one in an end or its near, and the phase hand part material which counters this shaft through liquid bearing clearance.

## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the liquid bearing equipment used for information machines and equipment, sound and a visual equipment, a business machine, etc., and relates to the optimal liquid bearing equipment for a magnetic disk drive (it is described as HDD henceforth), an optical disk unit, etc. especially.

[0002]

[Description of the Prior Art] As this conventional kind of liquid bearing equipment, there is a spindle motor for HDD as shown in drawing 2 , for example. Interpolation of the housing 100 of the shape of a cylinder object which has bottom plate 100a is carried out inside body 101a set up at the base 101, and these have fixed this thing in one. And to the inner skin of housing 100, interpolation of the cylinder object-like sleeve 102 is carried out, and it has fixed in one.

[0003] Furthermore, the shaft 103 is inserted in the sleeve 102 free [ a revolution ]. The reverse cup-like hub 104 is attached in the upper bed of a shaft 103 in one, and the disc-like thrust plate 105 has fixed by press fit in the soffit of a shaft 103. Let both the flat surfaces of this thrust plate 105 be the thrust abutments 105s and 105s of the thrust liquid bearing S. And the soffit side of the sleeve 102 which is phase hand part material counters 105s of upper thrust abutments through the liquid bearing clearance between the thrust liquid bearings S, and the soffit side of a sleeve 102 is made into 102s of thrust bearing sides of the thrust liquid bearing S.

[0004] Moreover, the top face of bottom plate 100a of the housing 100 which is phase hand part material counters 105s of lower thrust abutments through the liquid bearing clearance between the thrust liquid bearings S, and the top face of this bottom plate 100a is made into 100s of thrust bearing sides of the thrust liquid bearing S in them. And at least the above-mentioned thrust abutments 105s and 105s and thrust bearing surfaces [ 102s and 100s ] one side is equipped with the slot for dynamic pressure generating of the shape of the shape of a herringbone, and a spiral (not shown), and the thrust liquid bearing S is constituted.

[0005] Furthermore, spacing is set to the peripheral face of a shaft 103 up and down, and the radial abutments 103r and 103r of a couple are formed in it. Moreover, the radial abutments 103r and 103r are counterered through the liquid bearing clearance between the radial liquid bearings R, and the radial bearing sides 102r and 102r are formed in the inner skin of a sleeve 102. And at least one side of the radial abutments 103r and 103r and the radial bearing sides 102r and 102r is equipped with the slot 107,107 for dynamic pressure generating of the shape of the shape of a herringbone, and a spiral, and the radial liquid bearings R and R are constituted.

[0006] And peripheral surface opposite is carried out through the Rota magnet 109 and gap which a stator 108 is fixed to the peripheral face of housing 100, and are being fixed to the inner skin bottom of a hub 104, drive-motor M is formed and revolution actuation of a shaft 103 and the hub 104 is carried out by this drive-motor M in one. If a shaft 103 rotates, dynamic pressure occurs to the lubricant of the minute amount with which the liquid bearing clearance between each liquid bearings S and R was filled up, and a shaft 103 will serve as the inner

skin of a sleeve 102 and the top face of bottom plate 100a, and non-contact, and will be supported by pumping operation of each slot for dynamic pressure generating of the thrust liquid bearing S and the radial liquid bearing R.

[0007] In such a conventional spindle motor, the thrust plate 105 is not formed in one with a shaft 103, and the shaft 103 serves as another object. That is, after processing a shaft 103, the thrust plate 105 was pressed fit in the shaft 103, and is attached. In the case of the shaft (that in which the shaft and the thrust plate are formed in one) which has a flange, it is necessary to establish a center hole required in order to perform the grinding process of the peripheral face of the shaft used as the bearing surface in the end face of a shaft. However, since it is possible to perform a grinding process using a pin center, large loess grinder etc. in the case of the shaft (straight shaft) of the shape of a rod which does not have the above flanges, it is not necessary to establish a center hole in the end face of a shaft.

[0008]

[Problem(s) to be Solved by the Invention] In recent years, improvement in recording density is called for, and since the width of face of the truck for recording information is narrow, as for HDD, adoption of a liquid bearing with high rotational accuracy is considered. Furthermore, in HDD carried in a pocket device like a notebook sized personal computer, while thin shape-ization is called for, it excels in portability ability (shock resistance beyond 800G), and highly reliable (even if an operating environment changes, it is hard to generate an unstable oscillation) liquid bearing equipment is called for.

[0009] There is the approach of making unit elevation low by making thickness of a thrust plate 105 thin as an approach for realizing thin shape-ization. However,

when thickness of a thrust plate 105 is made thin, there is an inclination for the fixing reinforcement at the time of pressing fit in a shaft 103 to become weak. Therefore, when the big impact joined the spindle motor at the time of haulage etc., there was a possibility that a thrust plate 105 might be omitted from a shaft 103.

[0010] As an approach of solving such inconvenience, there is the approach of forming a shaft and a thrust plate in one. If a shaft and a thrust plate are one, even if an impact is added, there will be no fear of omission. However, in the shaft which has such a flange, in order to perform the grinding process of the peripheral face of the shaft used as the bearing surface using a grinder etc., as mentioned above, it is necessary to establish a center hole in the end face of a shaft. Then, the grinding process of a shaft can be performed using a cylindrical grinder, an angular grinder, etc.

[0011] On the other hand, the restoration approach of the lubricant in the conventional spindle motor was as follows. First, lubricant is poured in into housing 100 (on top face of bottom plate 100a). Then, a shaft 103 is inserted into housing 100 and the flat surface (it sets to drawing 2 and is a lower flat surface) of a thrust plate 105 is made to counter the top face of bottom plate 100a like drawing 2. The sleeve 102 was inserted into housing 100 after that, inserting a shaft 103 in a sleeve 102, and the sleeve 102 was fixed by press fit in housing 100.

[0012] Therefore, when the end face of a shaft is equipped with the center hole and it is filled up with lubricant by such approach, there is a possibility of air being confined in a center hole and remaining. Therefore, when it is the operating environment from which an atmospheric pressure and temperature

change, in order for the air which remained to expand, and to move in the inside of liquid bearing clearance and to circle, it is easy to generate an unstable oscillation during a revolution.

[0013] That is, when the shaft and the thrust plate were formed in one for thin-shape-izing and improvement in shock resistance, it becomes easy to generate an unstable oscillation by change of an operating environment, and the spindle motor had the trouble that dependability became scarce. Then, this invention makes it a technical problem to offer the liquid bearing equipment which an unstable oscillation cannot generate easily, even if it solves the trouble which the above conventional liquid bearing equipments have, and is a thin shape, and it excels in shock resistance and an operating environment changes.

[0014]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention consists of the following configurations. That is, the liquid bearing equipment of this invention is characterized by having been filled up with the bulking agent in said crevice, and taking up this crevice in the liquid bearing equipment which equips with a crevice the end face of the side in which said flange was prepared among the ends sides of said shaft while it is equipped with the shaft which has the flange formed in one in an end or its near, and the phase hand part material which counters this shaft through liquid bearing clearance.

[0015] In case it is filled up with lubricant in liquid bearing equipment with such a configuration, a possibility that air may remain in said crevice is small. Therefore, even if the operating environment of liquid bearing equipment is an environment where an atmospheric pressure and temperature change, it is hard

to generate an unstable oscillation at the time of a revolution. Moreover, since the shaft and the flange are formed in one, liquid bearing equipment is excellent in shock resistance, and it is [thin-shape] easy to use it.

[0016] In addition, although especially the class is not limited if said bulking agent can take up said crevice and it does not drop out easily, adhesives, a sealing compound, etc. are used suitably.

[0017]

[Embodiment of the Invention] The gestalt of operation of the liquid bearing equipment concerning this invention is explained to a detail, referring to a drawing. Drawing 1 is drawing of longitudinal section of the thin spindle motor for HDD which is 1 operation gestalt of the liquid bearing equipment concerning this invention. First, the structure of a spindle motor is explained.

[0018] This spindle motor consists of a shaft 13 which the hub 14 fixed, and a sleeve 12 in which this shaft 13 was inserted, and the radial liquid bearing R is infixed between the shaft 13 and the sleeve 12. In addition, interpolation of the sleeve 12 was carried out to the cylinder object-like housing 10, and it is fixed. Moreover, the flange 15 is formed in the end of a shaft 13 in one, and the thrust liquid bearing S is formed between both the flat surfaces of a flange 15, and the sleeve 12 and housing 10 which counter this. In addition, a sleeve 12 and housing 10 are equivalent to the requirements slack phase hand part material for a configuration of this invention.

[0019] Peripheral surface opposite is carried out through the Rota magnet 19 and gap which the stator 18 is being fixed to the peripheral face of housing 10, and were fixed to the inner skin of a hub 14, and drive-motor M is formed. And if revolution actuation of a hub 14 and the shaft 13 is carried out in one by

drive motor M, a shaft 13 will be supported by the thrust liquid bearing S and the radial liquid bearing R free [ a revolution ] to a sleeve 12.

[0020] Next, the structure of the above spindle motors of this operation gestalt is further explained to a detail. Inside body 11a set up at the base 11, interpolation of the housing 10 of the shape of a cylinder object which has bottom plate 10a is carried out, and these have fixed in one. And to the inner skin of housing 10, interpolation of the cylinder object-like sleeve 12 is carried out, and it has fixed in one.

[0021] The shaft 13 is inserted in the sleeve 12 free [ a revolution ]. Although it is not limited especially if it is the ingredient which whose hardness was [ the construction material of a shaft 13 ] high, and was excellent in corrosion resistance, what surface treatment by the thing or plating, and the diamond-like carbon (DLC) film which it heat-treated [ film ] to the stainless steel and austenitic stainless steel of a martensite system, and made them harden a front face for example was performed [ what ], and stiffened the front face is raised.

[0022] Upper bed section 13a of this shaft 13 is a minor diameter from the other sections, and the shaft 13 and the hub 14 have fixed to one by pressing fit in the hole in which this minor diameter upper bed section 13a was prepared in the center section of the hub 14 of the shape of a shallow reverse cup. And since it is said major diameter which it is minor diameter upper bed section 13a and a major diameter, and also is formed in a boundary line with the section and also the underside of a hub 14 is contacted by upper bed side 13b of the section, a shaft 13 and a hub 14 fix by the reinforcement which is sufficient for securing sufficient shock resistance.

[0023] Moreover, the disc-like flange 15 is formed in the soffit of the shaft 13

which projected from the soffit of a sleeve 12 in one with the shaft 13. Since this flange 15 is formed in a shaft 13 and one, it does not have a possibility of dropping out of a shaft 13 also considering a strong impact as a carrier beam (it excels in shock resistance). Moreover, since unit elevation can be made low by making thickness of a flange 15 thin, thin shape-ization of a spindle motor becomes easy.

[0024] The underside of a flange 15 has countered with the top face of bottom plate 10a of the housing 10 which is phase hand part material and is equivalent to a counter plate, and said both sides which counter have contacted at the time of a halt of a spindle motor. Moreover, the top face of a flange 15 has countered with the soffit side of the sleeve 12 which is phase hand part material. Let both the flat surfaces of the upper and lower sides of a flange 15 be the thrust abutments 15s and 15s. And the soffit side of the sleeve 12 which counters 15s of upper thrust abutments through the liquid bearing clearance between the thrust liquid bearings S, The top face of bottom plate 10a of the housing 10 which counters 15s of lower thrust abutments through the liquid bearing clearance between the thrust liquid bearings S Among the thrust abutments 15s and 15s which face being used as the thrust bearing sides 12s and 10s, respectively, and the thrust bearing sides 12s and 10s, at least to one side For example, it has the slot for dynamic pressure generating of the shape of the shape of a herringbone, or a spiral (not shown), and the thrust liquid bearing S is constituted.

[0025] In addition, especially the processing approach of establishing the slot for dynamic pressure generating in both the flat surfaces (thrust abutments 15s and 15s) of a flange 15 is not limited, and plastic working, cutting, chemical etching, electrolytic etching, etc. are raised. Since coining processing which is plastic

working is the approach of stamping said slot for dynamic pressure generating by pressing metal mold to a flange 15 using a press etc., it is excellent in mass production nature as compared with etching processing, and is low cost.

[0026] moreover, the inner skin of a sleeve 12 -- the -- the whole surface has countered with the peripheral face of a shaft 13 mostly. The part of the angle of the upper bed (open air side) of the inner skin of a sleeve 12 is beveled as shown in drawing 1 , and it is set to inclined plane 12a. By this, the part of an upper bed (open air side) serves as the taper-like configuration where clearance becomes large gradually toward an open air side (upper part), most among the clearance formed between the peripheral face of a shaft 13, and the inner skin of a sleeve 12.

[0027] With such a configuration, it can prevent that lubricant leaks out outside from liquid bearing clearance at the time of quiescence of a spindle motor, and a revolution. In addition, the slot 17 for dynamic pressure generating is not established in the part of the clearance between this taper-like configuration, therefore the part of the clearance between this taper-like configuration is not the liquid bearing clearance between the radial liquid bearings R so that drawing 1 may show.

[0028] In addition, in this operation gestalt, although inclined plane 12a is prepared in the inner skin of a sleeve 12, it may be prepared in the peripheral face of a shaft 13, or may be prepared for the both sides of the inner skin of a sleeve 12, and the peripheral face of a shaft 13. In preparing inclined plane 12a in the peripheral face of a shaft 13, it prepares in the part by the side of the open air most among the parts which counter the inner skin of a sleeve 12.

[0029] Moreover, if oil-repellent processing of applying an oil repellent agent

(what has the property which crawls lubricant) to inclined plane 12a of a sleeve 12 and the part which counters inclined plane 12a among the peripheral faces of a shaft 13 is performed, since lubricant will be crawled by the part which performed oil-repellent processing, it can prevent more effectively that lubricant leaks out outside exceeding the part which performed oil-repellent processing at the time of quiescence of a spindle motor, and a revolution.

[0030] On the other hand, while setting spacing to shaft orientations and forming the radial abutments 13r and 13r of a couple in the peripheral face of a shaft 13 up and down, the radial bearing sides 12r and 12r which counter these radial abutments 13r and 13r through the liquid bearing clearance between the radial liquid bearings R are formed in the inner skin of a sleeve 12. And the radial bearing sides 12r and 12r are equipped with the slots 17 and 17 for dynamic pressure generating of the shape of a rough-elbowed herringbone, and the radial liquid bearings R and R are constituted. However, the slots 17 and 17 for dynamic pressure generating may be established in the radial abutments 13r and 13r, and may be established in the both sides of the radial abutments 13r and 13r and the radial bearing sides 12r and 12r.

[0031] In addition, especially the processing approach of forming this slot 17 for dynamic pressure generating is not limited, and the approach of the same common use as the above-mentioned is adopted. If the slot 17 for dynamic pressure generating is processed into the inner skin of radial bearing side 12r12, i.e., a sleeve, since the slot 17 for dynamic pressure generating is processible with plastic working, such as ball rolling excellent in mass production nature, or cutting by the cutting tool, it is desirable. Ball rolling is the approach of processing the rolling fixture which made two or more shots holding in the

hollow-like outer case inserted in the periphery of a shaft by pushing into a sleeve 12.

[0032] That is, by pushing in and carrying out relative displacement of the rolling fixture to a sleeve 12, carrying out forward counterrotation of the main shaft of an engine lathe slowly, after carrying out cutting of the sleeve 12 on an engine lathe, herringbone-like (rough-elbowed) recessing is performed to inner skin, and finish-machining the finishing cut which removes the climax part around a slot after that, ball through is performed if needed. Of course, it may push into the sleeve 12 fixed while carrying out forward counterrotation of the rolling fixture to right and left using rolling equipment instead of an engine-lathe top, and forming of rolling of the herringbone-like slot may be carried out.

[0033] That a flute length uses as a slightly short inside sense unsymmetrical slot pattern the direction located in an open air side among the slots 17 and 17 for dynamic pressure generating established in two places has a desirable direction inside an open air side by the following reasons. That is, since the pressure which pushes in lubricant toward the inside with a revolution of a shaft 13 from an open air side works (pump in), it is prevented that the lubricant in the liquid bearing clearance between the radial liquid bearings R disperses outside according to the centrifugal force accompanying a revolution of a shaft 13.

[0034] This is further explained to a detail. The slot 17 for dynamic pressure generating consists of two or more rough-elbowed slots put in order at the predetermined spacing along with the circumferencial direction of a shaft 13. The pattern makes the slot 17 (it sets to drawing 1 and is the upper slot 17 for dynamic pressure generating) for dynamic pressure generating located in an open air side among the slots 17 and 17 for dynamic pressure generating

established in two places a configuration unsymmetrical to shaft orientations. And the pattern of the slot 17 (it sets to drawing 1 and is the slot 17 for dynamic pressure generating on downward) for dynamic pressure generating on another side is made into a configuration symmetrical with shaft orientations.

[0035] That is, let width of face from a flection to the edge by the side of the open air be size in the slot 17 for dynamic pressure generating located in an open air side among [ width of face / from a flection to an inside edge ] the width of face of the shaft orientations of a rough-elbowed slot. In addition, in said open air side, in this operation gestalt, the side (it sets to drawing 1 and is the upper part) which is fit for the open air of a spindle motor, i.e., the thrust liquid bearing S is formed, means an opposite hand in a shaft 13. Moreover, as for the inside, an open air side means the side in which the opposite hand S, i.e., a thrust liquid bearing, is established.

[0036] Moreover, in order to lessen that air bubbles are involved in during a revolution to the lubricant in the liquid bearing clearance between the thrust liquid bearing S and the radial liquid bearing R, as for the slot for dynamic pressure generating established in the thrust liquid bearing S and the radial liquid bearing R, it is desirable to make preferably into 25 degrees or less 30 degrees or less whenever [ gash angle ] (include angle made to a hand of cut), and to make ten or more numbers of a slot or more into 12 preferably.

[0037] When the bearing width of face (width of face of the shaft orientations of the slot 17 for dynamic pressure generating) of the slot 17 for dynamic pressure generating of the shape of a herringbone especially prepared in the radial liquid bearing R is smaller than a shaft diameter, it is desirable to make whenever [ gash angle ] into 25 degrees or less, and to make 12 or more numbers of a slot or

more into 16 preferably. If air bubbles are involved in lubricant, it will become the cause of the unstable oscillation under revolution, and rotational accuracy will tend to deteriorate.

[0038] In addition, in order to make torque of a spindle motor small, the relief groove which becomes the inner skin (the peripheral face of a shaft 13 is sufficient, or the both sides of the inner skin of a sleeve 12 and the peripheral face of a shaft 13 are sufficient) of the sleeve 12 pinched by the radial liquid bearings R and R of two upper and lower sides from the circumferential groove of the shape of a taper to which clearance becomes narrow toward the liquid bearing clearance between the radial liquid bearings R may be prepared.

[0039] Moreover, shift a little the shaft-orientations location of the Rota magnet 19 which constitutes drive-motor M, and a stator 18, and it is made for the suction force of shaft orientations to act. The soffit side side of a sleeve 12 mainly shares a load. Further the effective area of 15s of thrust abutments of the flange 15 bottom You may make it reduce the bearing torque by the side of an anti-load (designs a bearing effective diameter small) by designing smaller than the effective area of 15s of upper thrust abutments. Then, power consumption of a spindle motor can be lessened.

[0040] Furthermore, although not prepared in the spindle motor of this operation gestalt, the annular clearance which consists of a taper side may be prepared between the peripheral face of a sleeve 12, and the inner skin of housing 10, and this annular clearance may be used for it as lubricant \*\*\*\*\*. At least one side of the peripheral face of a sleeve 12 and the inner skin of housing 10 which form the inner surface of lubricant \*\*\*\*\* is made into the taper side, and, thereby, as for lubricant \*\*\*\*\*, clearance is narrow gradually toward the downward thrust

liquid bearing S.

[0041] Moreover, the lubricant supply way which is carrying out opening toward the clearance in a circle formed between the peripheral face of a flange 15 and the inner skin of the housing 10 which is the member which counters it is established in the soffit of lubricant \*\*\*\*\*. And opening of the lubricant supply way which approaches the liquid bearing clearance between the thrust liquid bearings S, and is open for free passage is almost equal to the liquid bearing clearance between the thrust liquid bearings S, or is large slightly, and lubricant is tending to introduce [ come ] it into the liquid bearing clearance between the thrust liquid bearings S from a lubricant supply way according to the capillarity based on surface tension.

[0042] Although you may make it the whole lower part of lubricant \*\*\*\*\* form a lubricant supply way (that is, a lubricant supply way is annular clearance-like), a slit-like lubricant supply way may be established in one in the lower part of lubricant \*\*\*\*\*, and a slit-like lubricant supply way may be established in two or more places (that is, the peripheral face of a sleeve 12 and the inner skin of housing 10 touch, and other parts are embarrassed).

[0043] Such the upper part of lubricant \*\*\*\*\* is made to carry out opening of the air hole open for free passage to the open air. For example, it extends horizontally from the upper part of lubricant \*\*\*\*\*, it is crooked up on the way, it prepares (that is, as the slit of shaft orientations is formed in a fitting side with the sleeve 12 of housing 10, it is prepared in it), or extends vertically from the upper part of lubricant \*\*\*\*\* so that opening may be carried out to the upper bed side of a sleeve 12, and it prepares so that opening may be carried out to the upper bed side of a sleeve 12.

[0044] In such lubricant \*\*\*\*\* , lubricant is held according to the capillarity based on surface tension. And this lubricant is attracted with surface tension in the narrower one of clearance, on the other hand, it separates into the larger one of clearance and the residual air bubbles involved in at the time of an assembly are discharged through said air hole. And operation of a spindle motor attains to a long period of time, it is attracted in the narrower one of clearance, the lubricant which does not have the air bubbles in lubricant \*\*\*\*\* if the lubricant currently held in each liquid bearing clearance evaporates gradually, or disperses and runs short being guided in a taper side according to the insufficiency, and it is supplied until lubricant is filled in each liquid bearing clearance. That is, with reduction of the lubricant in each liquid bearing clearance, it is drawn in by capillarity via a lubricant supply way in each liquid bearing clearance where clearance is narrow, and is stabilized in the location where the surface tension of the taper side of lubricant \*\*\*\*\* balances. In this way, lubricant is automatically supplied only for the decrement of lubricant.

[0045] Thus, if it has lubricant \*\*\*\*\* , even if it carries out the rear-spring-supporter activity of the spindle motor at a long period of time, dependability is highly excellent [ lubricant is automatically supplied to each liquid bearing clearance certainly, and it will be in the condition of always having been filled with lubricant, and ] in endurance. Therefore, even if excess and deficiency are in the injection rate of lubricant, a possibility that lubricant may disperse outside or the lubricant in each liquid bearing clearance may be drained in a prolonged activity is small.

[0046] Next, the restoration approach of the lubricant to the spindle motor concerned is explained. Restoration of the lubricant to the spindle motor

concerned is performed in the middle of the assembly of a spindle motor. First, lubricant is poured in into housing 10 (on top face of bottom plate 10a). And a shaft 13 is inserted into housing 10 and the flat surface (it sets to drawing 1 and is a lower flat surface) of a flange 15 is made to counter bottom plate 10a like drawing 1. A sleeve 12 is inserted into housing 10 after that, inserting a shaft 13 in a sleeve 12, and a sleeve 12 is fixed by press fit in housing 10.

[0047] At this time, the center hole 20 is established in the end face of the side in which the flange 15 is formed among the ends sides of a shaft 13. In addition, this center hole 20 is equivalent to the requirements slack crevice for a configuration of this invention. Although it is unnecessary, such a center hole 20 is required of a straight shaft in the shaft which has a flange in order to perform the grinding process of the peripheral face of the shaft used as the bearing surface using a cylindrical grinder, a grinder like an angular grinder, etc.

[0048] And in the spindle motor of this operation gestalt, it fills up with the bulking agent in the center hole 20, and the center hole 20 is plugged up. If this bulking agent can plug up a center hole 20 and it does not drop out easily, although especially that class is not limited, adhesives, a sealing compound, etc. will be raised. Specifically as adhesives, silicon resin etc. can be illustrated as sealing compounds, such as epoxy system adhesives.

[0049] In addition, in case a center hole 20 is filled up with a bulking agent, in order to prevent that a bulking agent overflows a center hole 20 and adheres to 15s of lower thrust abutments, it is desirable to follow a center hole 20 and to form the shallow circular sulcus 21 (for it to set to drawing 1 and to be the slot of depth H) in the perimeter of a center hole 20. Then, since it is contained in a circular sulcus 21 even if a bulking agent overflows a center hole 20, a possibility

of adhering to 15s of lower thrust abutments is small.

[0050] When the end face of a shaft 13 is equipped with the center hole 20 and it is filled up with lubricant by the above approaches, a possibility of air being shut up in a center hole 20 and remaining is large. When it does so and is the operating environment from which an atmospheric pressure and temperature change, in order for the air which remained to expand, and to move in the inside of liquid bearing clearance and to circle, it is easy to generate an unstable oscillation during a revolution.

[0051] However, since the center hole 20 is beforehand closed by the bulking agent, as for the spindle motor of this operation gestalt, air does not remain in a center hole 20 at the time of the assembly of a spindle motor, and impregnation of lubricant. For this reason, it is hard to produce the unstable oscillation under the effect of air bubbles during a revolution. In addition, you may make it fill up each liquid bearing clearance with lubricant, in order to make deaeration of air bubbles more reliable, since the residual of few air bubbles also becomes the factor which causes an unstable oscillation, putting in and carrying out [ use the lubricant which carried out the vacuum deairing beforehand, or ] the vacuum deairing of the spindle motor to a vacuum tub as occasion demands, after pouring in lubricant.

[0052] Moreover, impregnation of the lubricant to a spindle motor may be performed by the following approaches. That is, the through hole which consists of a run through hole of the thickness direction is prepared in the core of bottom plate 10a, and after assembling the whole, lubricant may be poured in from said through hole using a dispenser etc. After pouring lubricant into a spindle motor, a ball, body material, etc. are pressed fit in said through hole, and this through

hole is sealed.

[0053] If such a spindle motor carries out revolution actuation of the hub 14 and shaft 13 which carry the magnetic disk which is body of revolution-ed, and which is not illustrated in the periphery section in one by drive-motor M, dynamic pressure occurs to the lubricant with which the liquid bearing clearance between each liquid bearings S and R is filled up, and a shaft 13 will serve as bottom plate 10a of a sleeve 12 and housing 10, and non-contact, and will be supported by pumping operation of each slot for dynamic pressure generating of the thrust liquid bearing S and the radial liquid bearing R. In addition, since the stop of said magnetic disk is \*\*\*\*ed and carried out by the clamp member, it has fixed by the reinforcement which is sufficient for securing sufficient shock resistance.

[0054] In addition, this operation gestalt shows an example of this invention, and this invention is not limited to this operation gestalt. For example, a sleeve fixed-shaft revolution type is sufficient as a spindle motor, and an axial fixed-sleeve revolution type is sufficient as it. Moreover, the location of a flange 15 established in a shaft 13 may be the center section of the shaft not only an axis end but near the axis end.

[0055] Furthermore, bottom plate 10a which is the member (it is equivalent to a counter plate) which the spindle motor of this operation gestalt counters with the underside of a flange 15, and forms the thrust liquid bearing S is united with housing 10. However, of course, such a configuration not a configuration which the part of bottom plate 10a has on housing 10 and another object does not interfere at all. Moreover, a configuration with which housing 10 and the base 11 are united does not interfere at all, either.

[0056] Furthermore, if it is not limited to this operation gestalt and the object of

this invention can be attained about the structure of the structure of a liquid bearing, the pattern of the slot for dynamic pressure generating, and the details of a spindle motor etc., changing suitably if needed is possible. As long as the slot for dynamic pressure generating is not limited the shape of a herringbone, or in the shape of a spiral and functions as a dynamic pressure liquid bearing, what kind of slot pattern is sufficient as it further again. Moreover, the processing approach of this slot can apply etching, electrolytic etching, plastic working, cutting, laser beam machining, ion beam machining, shot blasting, etc. according to construction material or required accuracy.

[0057] Furthermore, especially the construction material of the member which constitutes the spindle motor of a shaft 13 and sleeve 12 grade is not limited, and if it is ingredients, such as metals (stainless steel, a copper alloy, aluminum containing alloy, etc.) usually used for the member which constitutes a spindle motor, a sintered metal, a sintering oil impregnation metal, plastics, and a ceramic, it can be used satisfactory. That is, the combination of stainless steel and copper alloys is sufficient, the combination of dissimilar metals, such as iron, a copper alloy and iron, and an aluminum containing alloy, is sufficient, and combination, such as a metal and plastics, is sufficient further. Of course, plating and surface treatment like the DLC film (diamond-like carbon coating) may be performed to the fluid bearing surface if needed, and the sliding nature at the time of deactivation may be raised.

[0058] Furthermore, in this operation gestalt, although the spindle motor was illustrated and explained as liquid bearing equipment, this invention is applicable to other various liquid bearing equipments.

[0059]

[Effect of the Invention] As mentioned above, the liquid bearing equipment of this invention is a thin shape, and even if it excels in shock resistance and an operating environment changes, an unstable oscillation cannot generate it easily.

#### DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing of longitudinal section of the spindle motor which is 1 operation gestalt of the liquid bearing equipment concerning this invention.

[Drawing 2] It is drawing of longitudinal section of the conventional spindle motor.

[Description of Notations]

10 Housing

12 Sleeve

13 Shaft

15 Flange

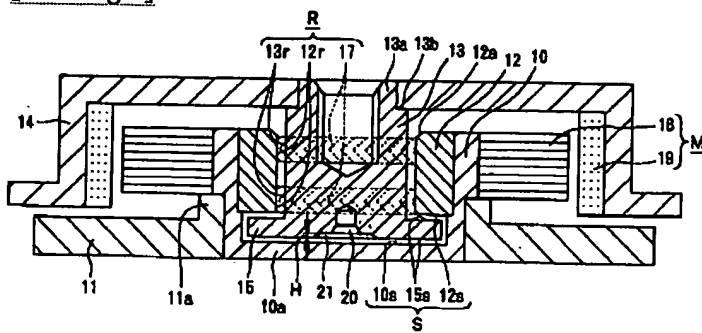
20 Center Hole

R Radial liquid bearing

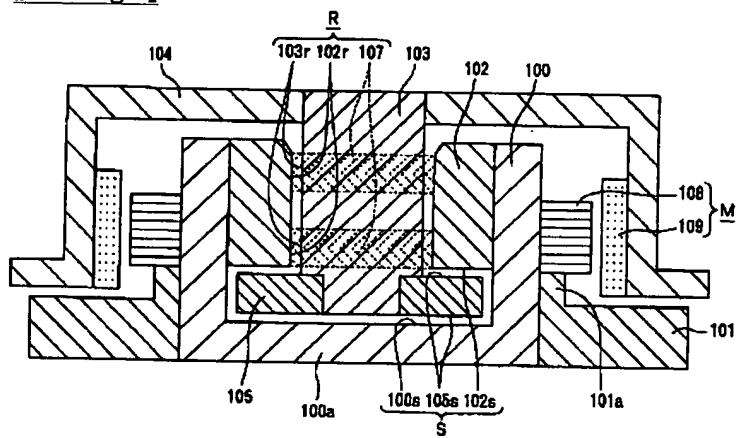
S Thrust liquid bearing

## DRAWINGS

**[Drawing 1]**



[Drawing 2]



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